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B. T. GALLOWAY, Chief of Bureau.

BARLEY CULTURE IN THE NORTHERN GREAT PLAINS.

BY

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Cerealist in Charge of Grain Investigations.

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BARLEY CULTURE IN THE NORTHERN GREAT PLAINS.

DEVELOPMENT OF THE INDUSTRY.[a]

The barley crop throughout the larger part of the United States is one that has been rapidly growing in importance in recent years. Its growth has been especially rapid in the north-central States and the northern States of the Great Plains, partly at least because of the fact that these two districts are particularly well adapted for barley cultivation. It is also true that the use of barley in stock feeding has increased a great deal in recent years.

Preceding the year 1901, the largest crop recorded for the United States was that of 1895, amounting to 87,720,744 bushels. In 1901 there was a crop of 109,932,924 bushels. Since that time there has been a fairly constant increase, until in 1906 the production was 178,916,484 bushels, of which 38,725,400 were harvested in North Dakota and South Dakota. These figures are taken from the Crop Reporter of this Department, issue of January, 1908. From the figures given in this same publication it is apparent, also, that there has been considerable increase in the yield per acre, considering the yields in five-year periods for the past forty years. The increase in acre yields may be largely the result of the establishment of better varieties.

DISTINCT BARLEY DISTRICTS.

An investigation of barley cultivation in the northern States covering eight to ten years, conducted by the Bureau of Plant Industry in cooperation with the agricultural experiment stations in the different States, leads to the conclusion that there are two rather well marked barley districts in this region. One extends over Wisconsin, Minnesota, and adjacent areas, including the valley of the Red River of the North; the other extends over the northern

[a] Since 1900 this Bureau has conducted investigations with barley at a number of points in the northern Great Plains area, and a considerable amount of information of an accurate nature with respect to barley adaptation and cultivation in this region is now at hand. A large part of the work has been conducted in cooperation with the North Dakota and South Dakota agricultural experiment stations. With these investigations as a basis, the accompanying article has been prepared by Mr. Mark Alfred Carleton, Cerealist in Charge of Grain Investigations, and as there appears to be an immediate demand among the farmers of this area for such information, it is thought best to publish it in the form of a circular.—B. T. Galloway, *Chief of Bureau.*

portion of the Great Plains, including practically all of South Dakota, all of North Dakota except the extreme eastern portion, the Plains area of Montana, and small adjacent portions of Wyoming and Nebraska. The discussion of barley culture in this article must be understood to apply particularly to this second area—that of the northern Great Plains.

In physical geography the northern Great Plains area differs from that of the north-central States district approximately as follows: In the latter district there is much more rainfall, there are considerable areas of timber, and the climate is fairly cool; in the northern Great Plains district the average annual rainfall is much less than in the other district and becomes gradually smaller toward the West, there is very little or no timber, and the summers are hot. It is probably largely due to these differences in climate and soil that there is a corresponding difference with respect to the varieties of barley adapted to these different districts. From the investigations already mentioned, it has been quite thoroughly demonstrated that as a general thing the six-rowed barleys are much better adapted to the north-central States district, while in the northern Great Plains the two-rowed barleys succeed better.

COMPARISON OF YIELDS OF DIFFERENT VARIETIES IN THE NORTHERN GREAT PLAINS AREA.

In the following tables are shown the comparative yields of a number of different varieties of barley at several different experiment stations. At the State agricultural experiment station at Fargo, N. Dak., it is seen from the table of yields obtained as an average of five-years' tests that the six-rowed barleys have done a little better than the two-rowed varieties. This is in Red River Valley, and, as before stated, that valley appears to belong in the north-central States district as regards barley adaptation.

TABLE I.—*Average yields of varieties of barley for five years at the North Dakota Agricultural Experiment Station.*

N. Dak. accession No.	Variety.	Average number days maturing (4 years).	Rows in head.	Yield per acre.					
				1902.	1903.	1904.	1906.	1907.	Average, five years.
				Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
107	Russian	84	6	83.3	39.0	26.6	17.9	46.9	42.7
966	Common	83	6	63.1	40.1	30.2	18.3	61.2	42.5
719	Silver King	84	6	55.3	40.2	27.2	19.5	58.1	40.0
871	Mandscheuri	82	6	55.7	39.4	31.6	15.0	60.8	40.3
789	Bernards	84	6	56.3	38.0	29.4	16.9	54.3	38.3
847	Highland Chief	95	2	45.0	42.7	40.7	11.0	47.5	37.3
649	Moravian	85	2	48.9	40.2	33.1	16.6	53.2	40.4
172	Mansury	94	2	57.1	33.0	35.9	12.6	46.9	37.0
149	McEwans Hull-less	83	2	48.1	35.4	28.1	16.1	45.0	34.5
720	Great Beardless	81	6	49.3	34.9	19.5	17.1	41.0	32.3

Prof. J. H. Shepperd, agriculturist and vice-director of the North Dakota Agricultural Experiment Station, at Fargo, writes as follows concerning this matter:

> The trials of the North Dakota Station have been directed toward a study of the * * * two-rowed barley compared with the six-rowed strains and a comparison of yields with the hull-less and beardless sorts. The two-rowed strains produced plumper berries and on the average perhaps slightly better colored grain. The average of a five years' trial, however, with five six-rowed varieties against four two-rowed sorts gives a difference of 3.6 bushels per acre in yield in favor of the six-rowed strains.

It may well be noted that in these trials none of the pedigree two-rowed varieties obtained by the Department of Agriculture from Sweden have been included, though these varieties in other trials to be mentioned have had great weight in increasing the average of the two-rowed sorts. No results are yet available of any extensive trials made at other experiment stations in North Dakota, except for one year, 1907, at the Dickinson substation, where in trials of many barley varieties the two-rowed varieties greatly exceeded the six-rowed sorts in yield per acre. No trials have been made of different barleys in the eastern portion of Montana, but at the State station at Bozeman, where conditions influencing barley adaptation are likely to be very similar, the results of trials of a number of varieties covering the years 1900 to 1906, inclusive, show a considerable difference in the average yields in favor of the two-rowed varieties. A table giving a comparison of the yields of the two classes of barley at this station for the years mentioned is here given:

TABLE II.—*Yields of barley varieties at the Montana Agricultural Experiment Station for a seven-year period, 1900–1906, inclusive.*

Name of variety.	Group.	Standard weight per bushel.	Yield per acre.	Weight per bushel.	Days to maturity.
		Pounds.	*Bushels.*	*Pounds.*	
New Zealand	2-rowed	48	84.0	51.8	114
Kitzing (S. P. I. No. 5590)	2-rowed	48	80.7	57.8	111
California Prolific	2-rowed	48	75.9	52.5	113
Mandscheuri	6-rowed	48	66.3	51.1	108
Chevalier	2-rowed	48	66.1	52.8	112
Del Norte	6-rowed [a]	60	65.7	62.5	111
Kinna Kulla	2-rowed	48	55.9	50.5	111
Berkeley	2-rowed [b]	48	49.2	51.1	109

[a] Hull-less. [b] Beardless.

These data are calculated from the annual reports of the Montana Agricultural Experiment Station for the years 1904 and 1906. On page 159 of the second report a summary is given of the yields of different classes of barley, from which it is seen that the average yield of grain per acre in pounds for two-rowed barleys for the years 1905 and 1906 was 3,168, while that of six-rowed barleys (not hull-

less) was 2,496, or a difference of 672 pounds per acre in favor of the two-rowed barleys.

The variety trials with barley at the State Agricultural Experiment Station at Brookings, S. Dak., have been very extensive and interesting, and have covered the period from 1900 to 1907, inclusive. Some of the best varieties, however, were introduced much later than the others. In 1903 a severe hailstorm destroyed the entire crop of all small grains before harvest time. It is only possible, therefore, to give average yields that furnish any reliable information for the period of 1904 to 1907, inclusive. The results of these tests are strikingly in favor of the two-rowed barleys.

It is worth while to refer to these trials somewhat in detail. There were a good many more varieties of two-rowed barleys grown than of the six-rowed sorts. The names of the twenty best two-rowed varieties are here given in the order of yield, and also the names of the five best six-rowed varieties in the order of yield.

TABLE III.—*Twenty best two-rowed varieties in order of yield at the South Dakota Agricultural Experiment Station.*

G. I. No.	Name.	Yield per acre.	G. I. No.	Name.	Yield per acre.
		Bushels.			*Bushels.*
187	Swan Neck	46.7	158	Bavarian	41.3
35	Chevalier	44.9	159	....do	40.0
	Hannchen, S. P. I. No. 10585	44.9	27	Bohemian	39.9
	Chevalier, S. P. I. No. 10584	44.9	201	Kitzing	39.0
24	Hanna	43.3	48	Golden Melon	38.6
200	Chevalier	43.2		Princess, S. P. I. No. 10583	38.6
204	Bohemian	42.8	30	Hanna	38.2
203	Hanna	41.9		Primus, S. P. I. No. 10586	34.8
207	Lower Frankish	41.4	47	Striegum	34.1
26	Hanna	41.3	178	Sidney	33.9

TABLE IV.—*Five best six-rowed varieties in order of yield at the South Dakota Agricultural Experiment Station.*

G. I. No.	Name.	Yield per acre.	G. I. No.	Name.	Yield per acre.
		Bushels.			*Bushels.*
182	Odessa	46.6	170	Manchuria	39.0
184	Common six-rowed	41.6	78	Sangatsuka	28.3
	Minnesota No. 6	41.1			

The average yield of the five best two-rowed varieties for the four-year period specified is 44.9 bushels and that of the five best six-rowed varieties for the same period is 39.3 bushels, a difference of 5.6 bushels in favor of the two-rowed varieties.

There are several things of interest concerning these tests. Though the average yield of the six-rowed sorts is considerably lower than that of the two-rowed varieties, nevertheless the Odessa variety, originally from Russia, made an average yield of only one-tenth of a bushel less than that of the highest yielding two-rowed variety, the Swan Neck. Minnesota No. 6, which has stood the highest in many

barley trials at the Minnesota Agricultural Experiment Station, gave a yield here of over 5 bushels per acre less than that of the highest yielding two-rowed variety and of the Odessa variety of its own group. Minnesota No. 6 is a pedigree variety of many years' standing, developed from the Manchuria. In these same trials the Manchuria variety, of the original stock and not pure bred, made the lowest average yield of the five best six-rowed varieties. An interesting feature is the uniformly high yields per acre of the four best two-rowed varieties, which are pedigree barleys introduced from Sweden through Mr. D. G. Fairchild, Agricultural Explorer of the Bureau of Plant Industry, giving abundant proof of the value of the production of pure types of barley. The Hanna variety (G. I. No. 24) has been widely introduced throughout South Dakota and has become a rather popular barley, although in these trials it yielded the lowest of the five best two-rowed sorts.

In trials of a few varieties of barley at the Highmore, S. Dak., subexperiment station for the years 1903 to 1906, inclusive, the only six-rowed variety tested through all these years, Minnesota No. 6, really made an average yield of slightly more than that of the best of the two-rowed varieties. The difference, however, is very slight, and it is to be noted that the pedigree varieties introduced from Sweden, which gave such high yields at Brookings, were not included in these tests until the year 1905. Such varieties as these would have to be compared with Minnesota No. 6 to make a fair comparison, because of the thorough breeding of Minnesota No. 6 from a single original mother plant. All but one of these Swedish varieties during the years 1905 and 1906 gave yields considerably in excess of Minnesota No. 6.

TWO-ROWED COMPARED WITH SIX-ROWED BARLEY.

In recent years there has arisen a considerable rivalry between two-rowed and six-rowed barleys, and there has been much discussion as to the relative merits of these two classes of barleys. It is well known that the two-rowed barleys are generally used in Germany and are considered much better than the six-rowed varieties. In this country the six-rowed varieties have been in favor. This is no doubt partly owing to the fact that the six-rowed barleys have until recently been given more attention by the farmers, and have therefore obtained a foothold in this country. It is only recently, after the thorough investigation of many barley varieties already mentioned, that the difference in adaptation of these two groups of barleys to different portions of the country has been ascertained. This natural adaptation of the two groups to different areas appears to clear the situation nicely, at least from the

agricultural standpoint. As there seem to be good arguments from the commercial standpoint for the production of either class of barleys there is apparently no good reason why the farmer should not cultivate the particular barley which gives him the best acre yields, and in the region of the northern Great Plains there is no question but that this class is the two-rowed barleys.

BREEDING BETTER STRAINS.

Mention has been made of the superior productiveness of the thoroughly bred Swedish barleys and of the Minnesota No. 6 produced at the Minnesota Experiment Station, the former being two-rowed varieties and the latter representing the six-rowed group. From the results shown to be obtained by other barleys, there is not the slighest doubt that the superior yields of these highly bred barleys are due entirely to their thorough breeding, they having originated from stock no better than that of the ordinary sorts.

Since during recent years a large part of the attention of the agricultural experiment stations has been given to adaptation trials of many varieties, not much time has yet been given to breeding pure barley types in this country. In South Dakota the work has until recently been almost entirely a study of many varieties in adaptation trials. The work of the Minnesota Agricultural Experiment Station has already been mentioned. At the State station at Fargo, N. Dak., a great deal of time has been given to barley selection, and two very good pedigree varieties have been developed at that station: The Mandscheuri (Manchuria), N. Dak. Experiment Station No. 871, a six-rowed variety, and the "Mansury," N. Dak. Experiment Station No. 172, a two-rowed variety. A number of other pure types which do not yet appear to have developed into satisfactory strains, ready for distribution, are being handled by this experiment station.

MAINTAINING PURE SEED.

The subject of getting unmixed seed is of the greatest importance and should always receive careful attention. The farmer can not, of course, do accurate breeding exactly according to the methods employed by the experiment stations, but he can largely maintain the quality of the strain or variety he already possesses, keeping it fairly pure, well cleaned and graded, and occasionally selecting the best plants from the field for starting a small seed plat. It is especially important to keep two-rowed barley absolutely separate from six-rowed barley. It is better not to grow these two kinds even on the same farm. Many farmers over a large area should unite in growing strictly one kind of barley, after being fairly sure that they have selected the one most satisfactory.

CULTIVATION.

So much instruction in the way of cultivation of any crop depends upon the conditions in particular localities that it is not wise to make more than a few general statements in respect to this subject for a district of any size. There are, however, several principles of a general nature to be observed. In the first place, much of the larger portion of the area of the Great Plains has a comparatively low annual rainfall, and it is therefore important to use every measure for the conservation of moisture in the soil. This is to a large extent accomplished by thorough surface cultivation after occasional deep plowings. As a rule, it is important in this area that all plowing for spring grains should be done the preceding season, though there may be occasional local circumstances that would require a modification of this practice. After the plowing is done, it is at any rate certain that occasional surface cultivation, especially after rains, is of the greatest importance. It is an excellent thing to have barley follow a cultivated crop, such as Indian corn. In the western and northern portions of this area, some kind of sorghum may take the place of Indian corn. In the case of a number of experiments made at several experiment stations in the northern Great Plains, it has been found that the yields of barley and other small-grain crops after corn are considerably better than those obtained even after summer fallow, while at the same time the income from the cultivated crop is obtained in addition.

The rate of seeding will range from one to two bushels, depending upon the locality and particularly upon the amount of rainfall. There is no question that seeding should be done with a drill. A much better and more uniform stand is obtained in this way, and the grain is thus better protected from the action of dry winds, especially if drilled at right angles to the prevailing direction of the wind.

As already mentioned, special attention should be given to the quality of the seed. Not only should the seed be kept free from mixture at thrashing time and well cleaned and graded, but it is usually advisable to use home-grown seed if it is of good quality. Introduced seed is better only when it represents some new variety preferable to others of the same class or when it happens to come from a district a little better adapted for barley cultivation.

When barley is seeded at the usual time, it is harvested early enough to allow the producer to plow the stubble under, and as a result secure a better crop the following season. Professor Shepperd makes the following remark:

> I have known a farmer to start three gang plows at work plowing behind the binder when cutting early-sown barley, the gang plows turning over the 7-foot strip cleared by the binder. The sheaves fell on the plowed land and were shocked there, thus

avoiding the necessity of moving them again before they were loaded for thrashing. I am assured that the effect of this early plowing, which really approached the average summer fallow, gave a marked improvement on the next season's crop.

The young barley may be cultivated with a harrow to great advantage after attaining a height of three or four inches, particularly if this is done after rains. The loss of moisture due to the formation of a crust is thus prevented.

If possible, barley should not be allowed to be discolored by exposure to wet weather. Discoloration depreciates its value for commercial purposes. The crop should be harvested as soon as it is fully ripe. If barley is well stacked promptly after shocking, the color will be preserved, but a short exposure in the shock is frequently fatal to the good color of the kernel.

USES OF BARLEY.

Barley has recently acquired a steadier and stronger demand and is being more generally used every year. It is growing in favor for feeding to stock, especially for hog feeding. Barley-fed bacon is considered to be of much better quality than that produced from corn.

This crop has recently been more remunerative to the acre than either wheat or flax. It is a crop that fits in with other small grains to good advantage at the harvest and thrashing season because of its early maturity. Professor Shepperd is of the opinion that "barley as a grain for stall-feeding live stock in North Dakota seems destined to fill the place occupied by corn in States farther south. Feeding trials with horses, cattle, sheep, and hogs at this station demonstrate its value in the ration of each of these classes of live stock."

Approved:

JAMES WILSON,
Secretary of Agriculture.

WASHINGTON, D. C., *April 6, 1908.*

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